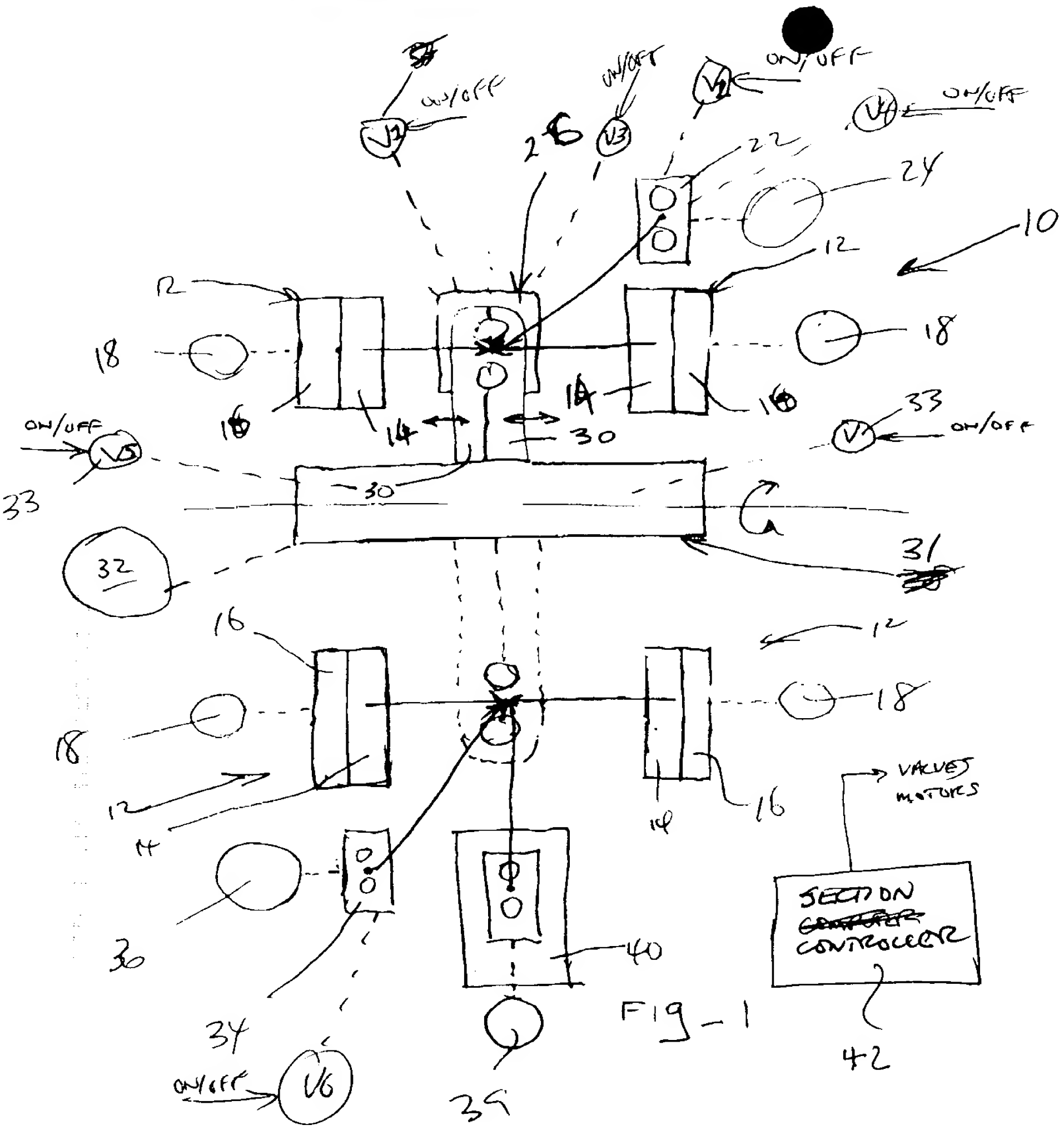

ON/OFF
V1
ON/OFF
V3
ON/OFF
V2
ON/OFF
V4
26
22
24
10
12
18
18
16
14
14
16
ON/OFF
V5
33
ON/OFF
V7
30
30
33
32
31
16
12
18
18
12
14
14
16
VALVES MOTORS
SECTION CONTROLLER
36
40
34
ON/OFF
V6
38
42

FIG-1

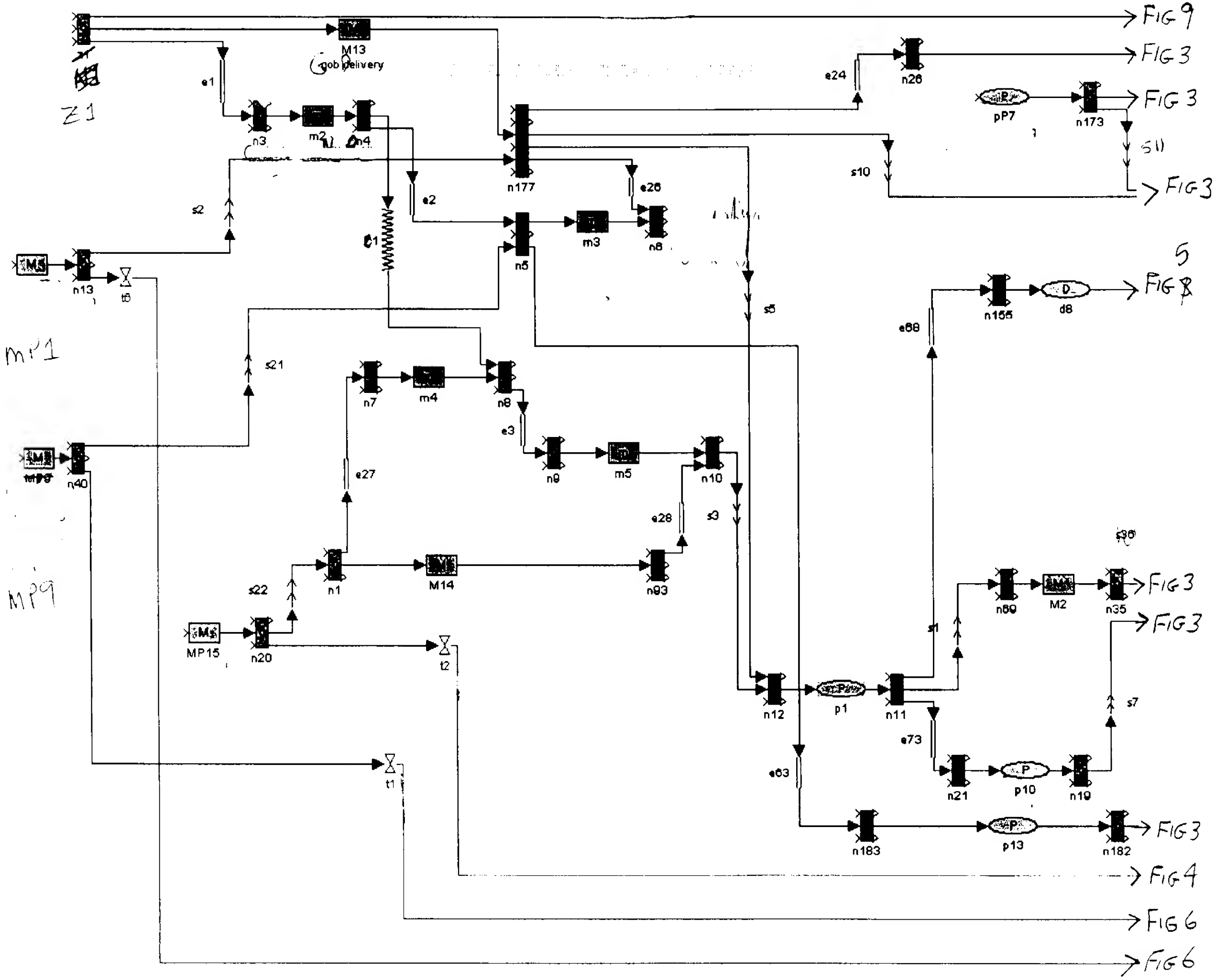

M13
gob delivery
e1
n3
m2
n4
e2
n177
e24
n26
FIG 9
FIG 3
pP7
n173
FIG 3
s11
s10
FIG 3
e26
m3
n6
s2
e1
n5
s5
M5
n13
t6
MP1
s21
n7
m4
n8
e3
n9
m5
n10
e27
e28
s3
M5
n40
M14
n93
s22
n1
M5
MP15
n20
t2
t1
n12
p1
n11
s1
n89
M2
n35
FIG 3
FIG 3
e73
s7
e63
n21
p10
n19
n183
p13
n182
FIG 3
FIG 4
FIG 6
FIG 6
n155
d8
FIG 8
e88
s36
MP9

FIG 2

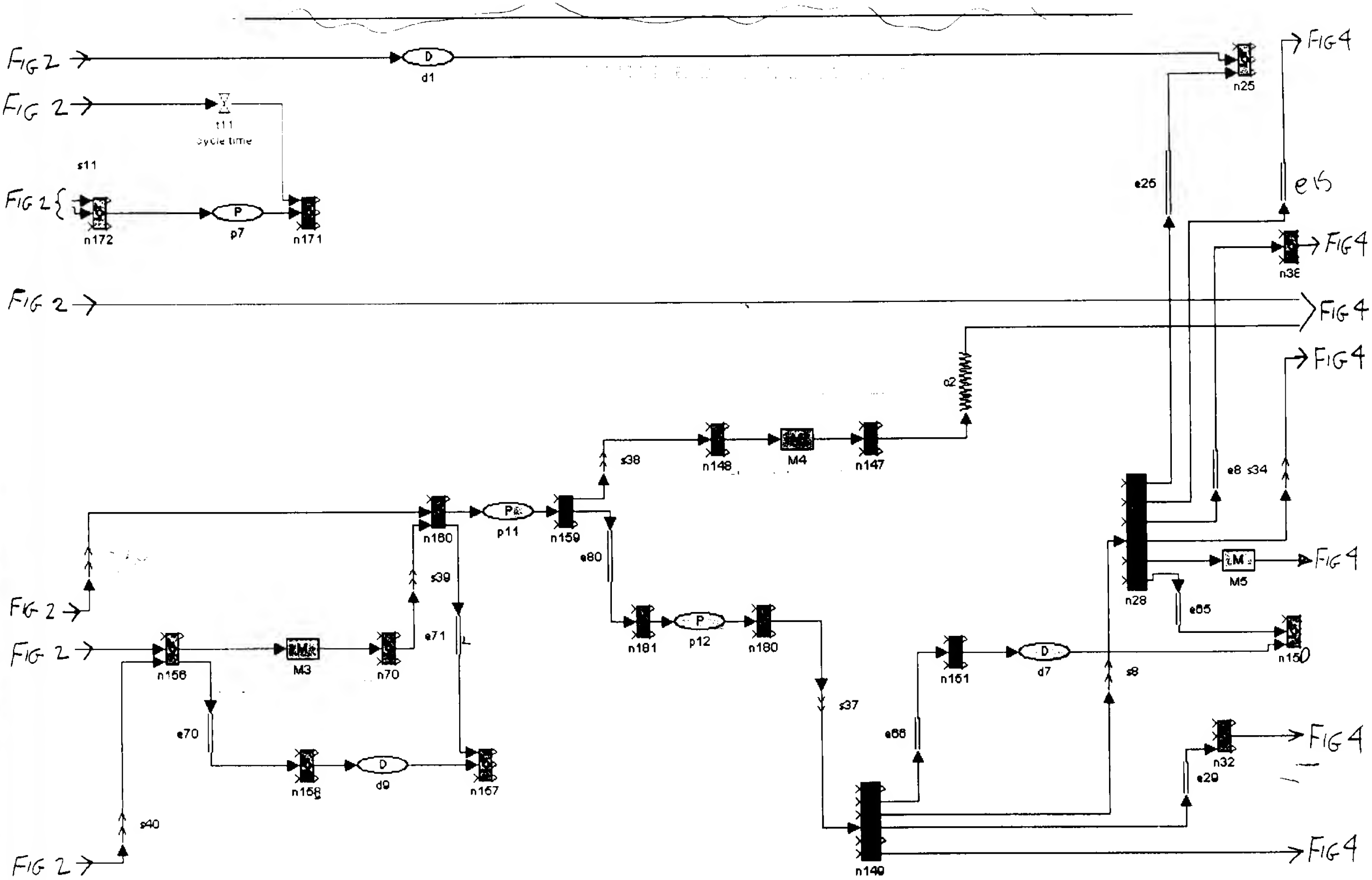


FIG 2
FIG 2
t11
cycle time
s11
FIG 2
n172
p7
n171
d1
n25
FIG 4
e26
e15
n38
FIG 4
FIG 2
FIG 4
R2
n148
M4
n147
s38
FIG 4
e8 s34
n160
p11
n159
e80
s39
M5
FIG 4
n28
e85
FIG 2
FIG 2
n156
M3
n70
e71
n181
p12
n180
n150
n151
d7
s8
s37
e70
e66
n32
e20
FIG 4
n158
d9
n157
s40
FIG 2
n149
FIG 4

FIG 3

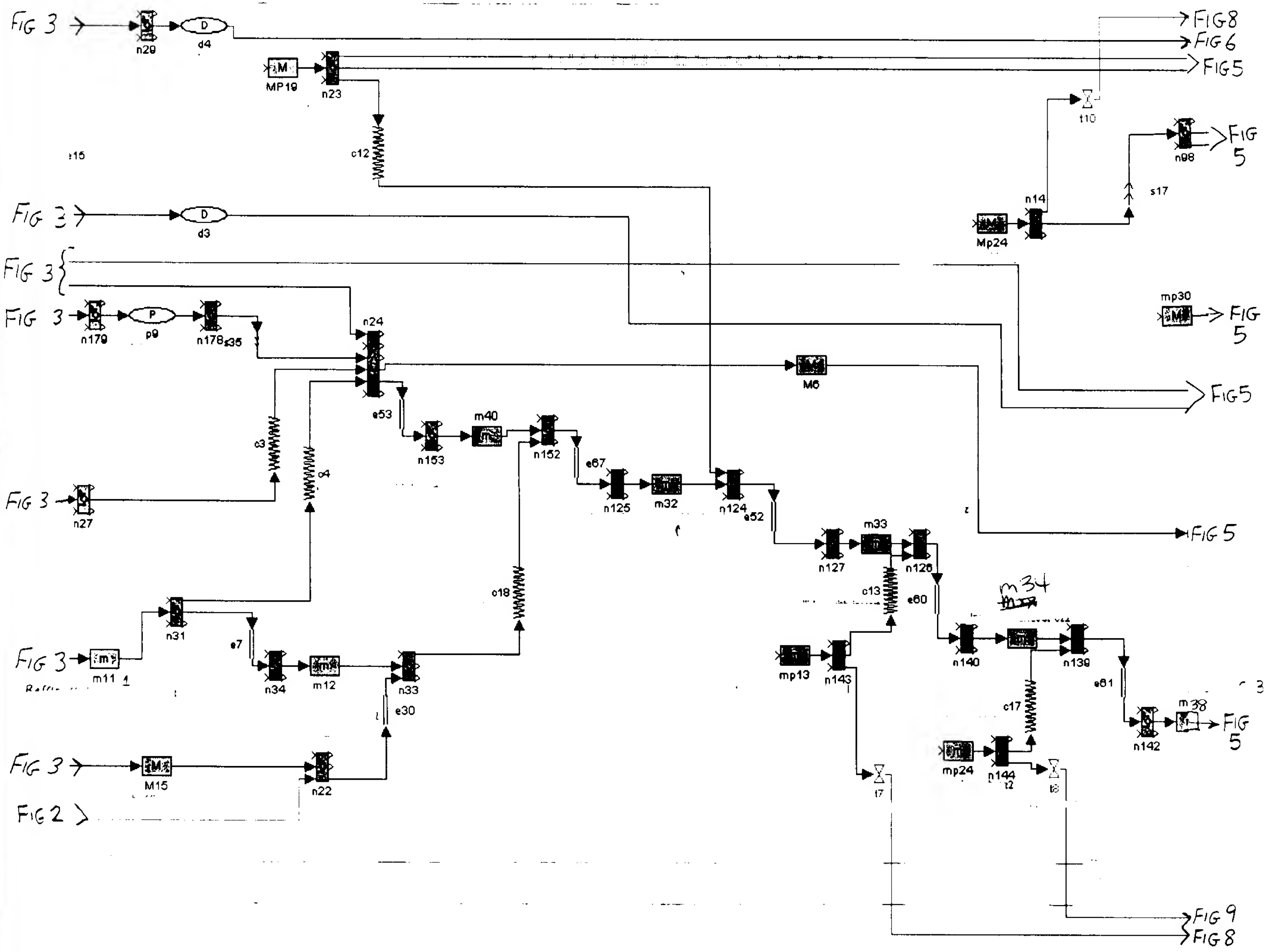


FIG 3
n29
D
d4
FIG8
FIG6
FIG5
MP19
n23
c12
t10
n98
FIG 5
s17
n14
Mp24
FIG 3
d3
FIG 3
FIG 3
n179
P
p9
n178
n24
mp30
FIG 5
M6
FIG5
e53
m40
n153
n152
e67
n125
m32
n124
e52
c3
c4
FIG 3
n27
m33
FIG 5
n127
n126
c13
e60
m34
c18
n31
e7
n140
n139
FIG 3
m11
n34
m12
n33
e30
e61
m38
FIG 5
n142
c17
mp13
n143
mp24
n144
t2
t8
t7
FIG 3
M15
n22
FIG 2
FIG 9
FIG 8

FIG 4

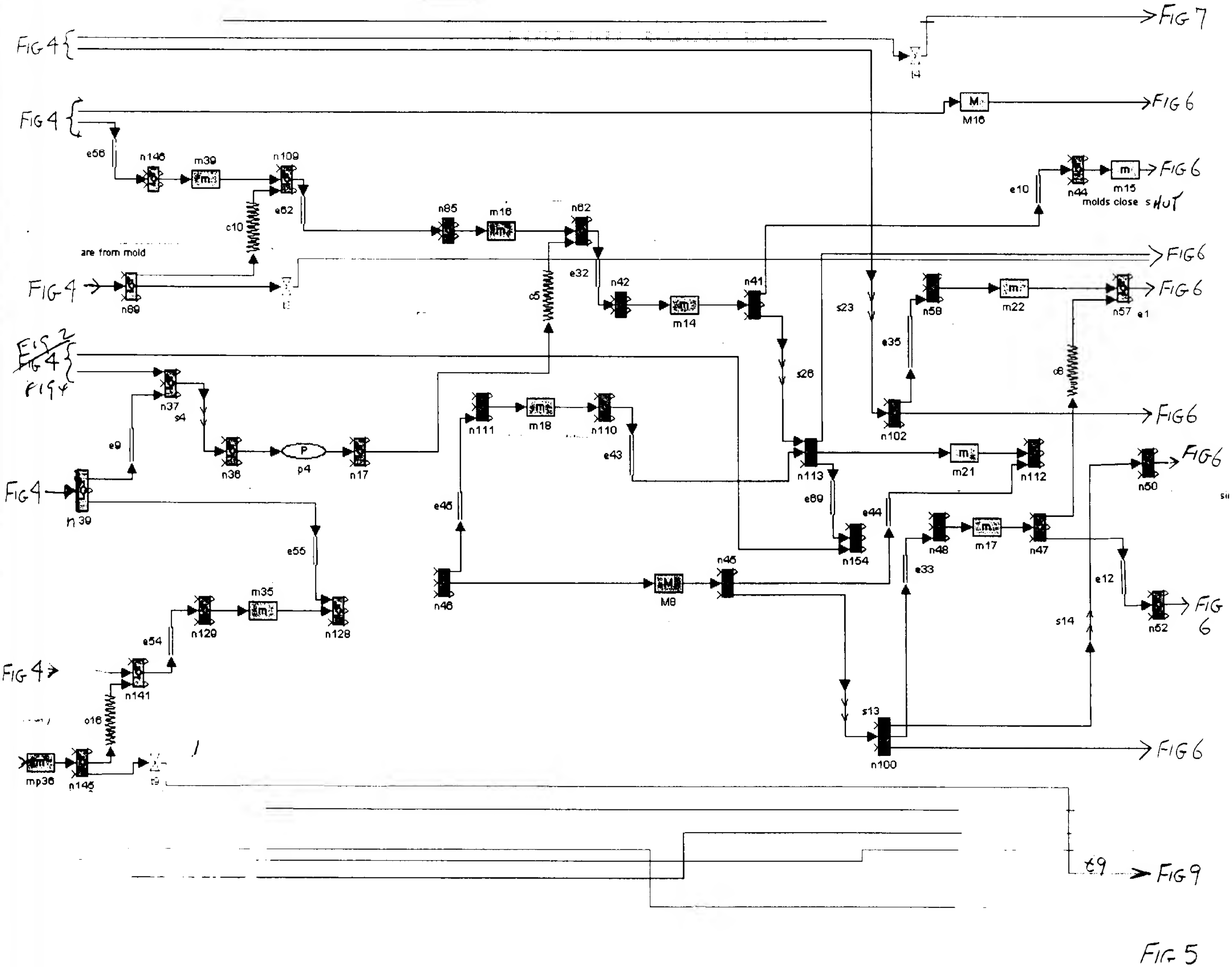


FIG 7
FIG 4
FIG 4
M16
FIG 6
e56
n146
m39
n109
e62
c10
n85
m16
n82
e10
n44
m15
FIG 6
molds close SHUT
are from mold
FIG 4
n89
FIG6
e32
n42
m14
n41
s23
n58
m22
n57
e1
FIG 6
FIG 2
FIG 4
FIG 4
c5
s26
e35
c8
n37
s4
n111
m18
n110
n102
FIG6
e9
n36
p4
n17
e43
m21
n112
n113
FIG6
n50
FIG 4
n39
e45
e69
e44
n154
n48
m17
n47
e55
n46
M8
n45
e33
e12
m35
n129
n128
s14
n52
FIG 6
e54
FIG 4
n141
c16
s13
n100
FIG 6
mp36
n145
t9
t9
FIG 9
FIG 5

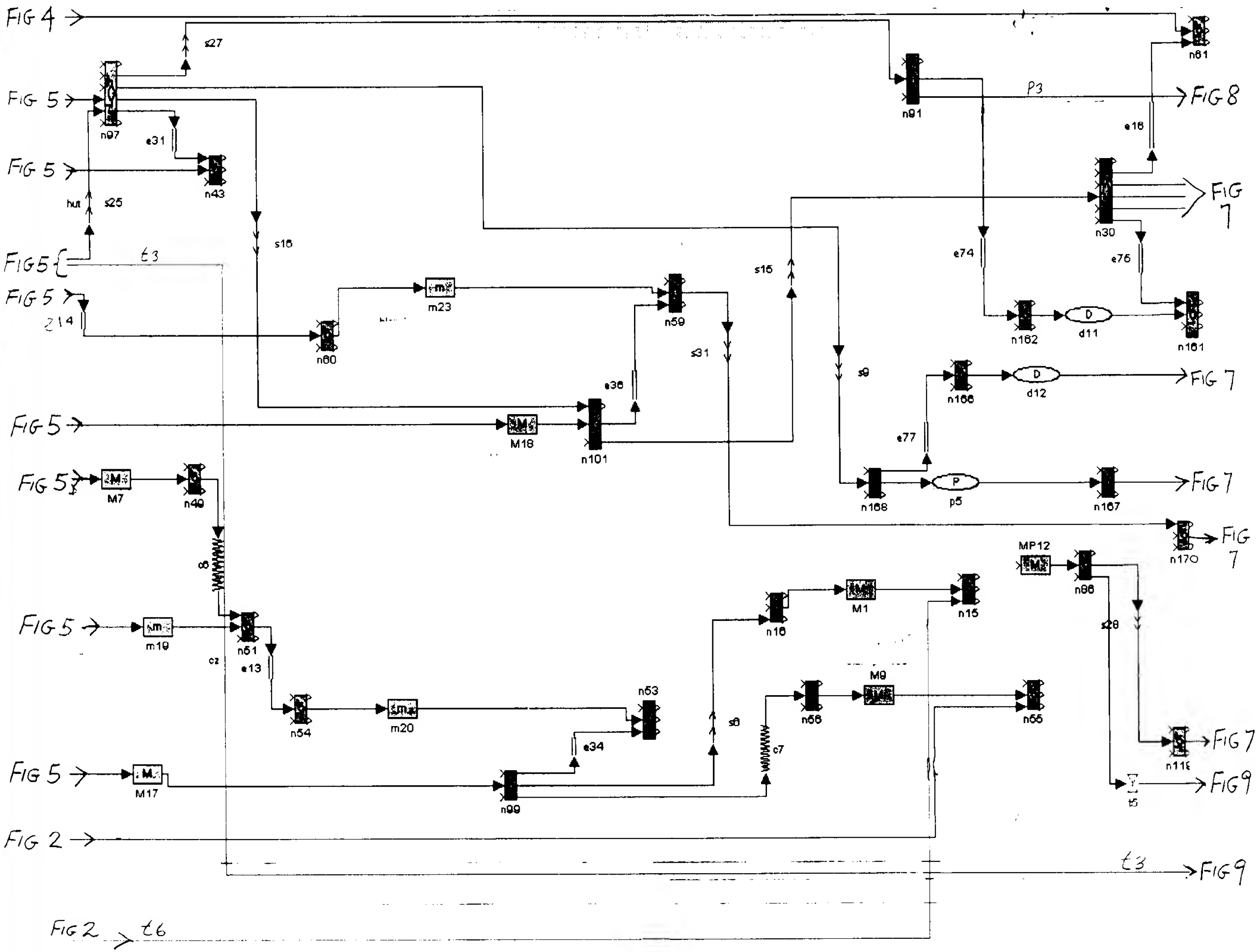


FIG 4
s27
n61
FIG 5
n97
e31
n91
p3
FIG 8
FIG 5
n43
e16
hut
s25
n30
FIG 7
s16
FIG5
t3
e74
e76
s15
FIG 5
m23
n59
n162
D
d11
n161
214
n60
s31
s9
e36
n166
D
d12
FIG 7
FIG 5
M18
n101
e77
FIG 5
M7
n40
n168
P
p5
n167
FIG 7
n170
FIG 7
MP12
n86
M1
n15
n16
s8
FIG 5
m19
n51
e13
n53
M9
n56
n55
n54
m20
s6
c7
e34
FIG 7
n118
FIG 5
M17
n99
FIG9
FIG 2
t5
t3
FIG9
FIG 2
t6

FIG6

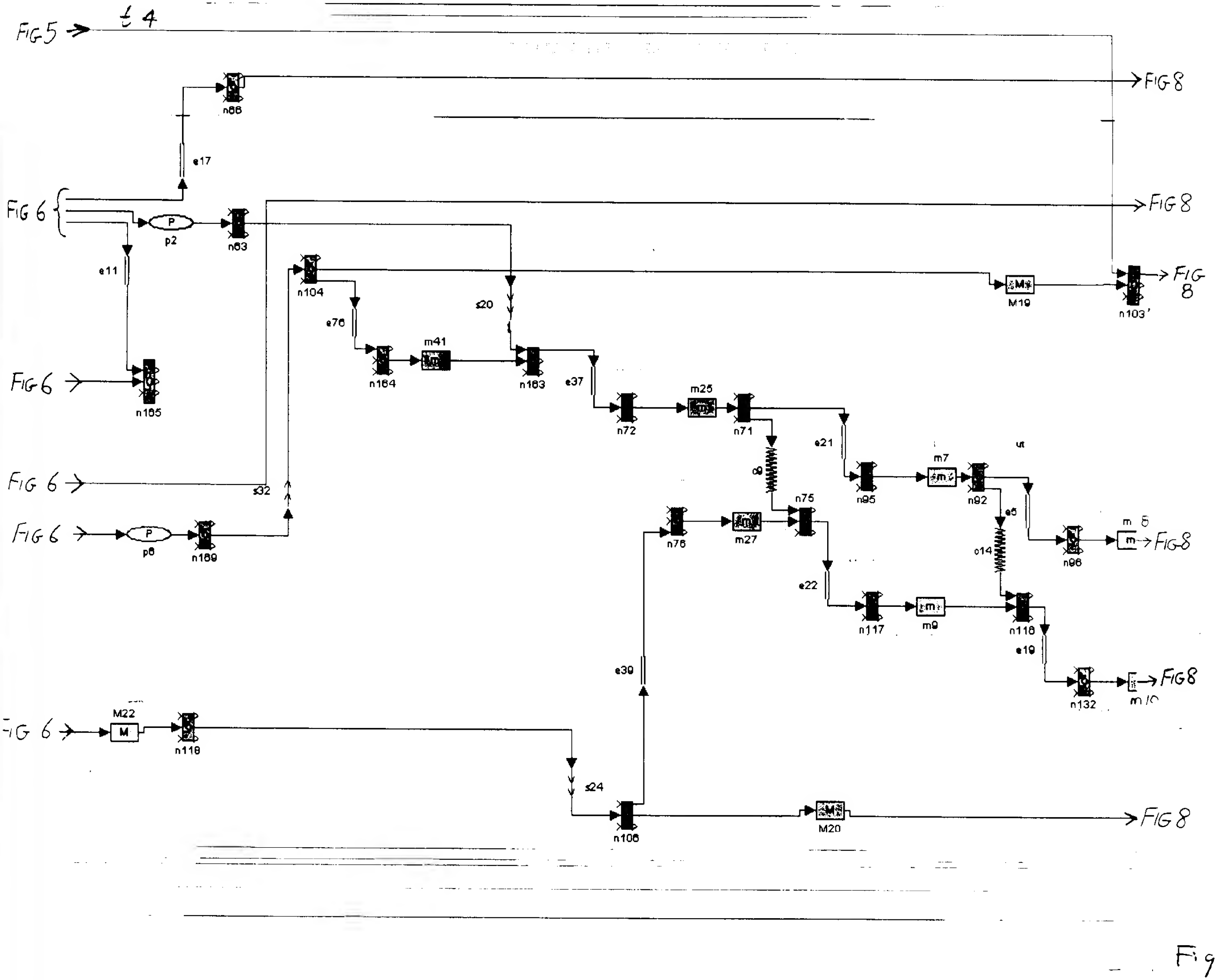


FIG 5
FIG 8
n86
e17
FIG 6
P
p2
n83
FIG 8
e11
n104
FIG 8
M19
n103'
e76
s20
m41
n164
n163
FIG 6
n165
e37
m25
n72
n71
e21
m7
FIG 6
s32
n95
n92
n75
e9
e5
n76
m27
n96
m 8
FIG 8
FIG 6
p8
n169
e14
e22
n117
m9
n118
e19
e39
n132
m 10
FIG 6
M22
M
n118
FIG 8
s24
n106
M20

Fig 7

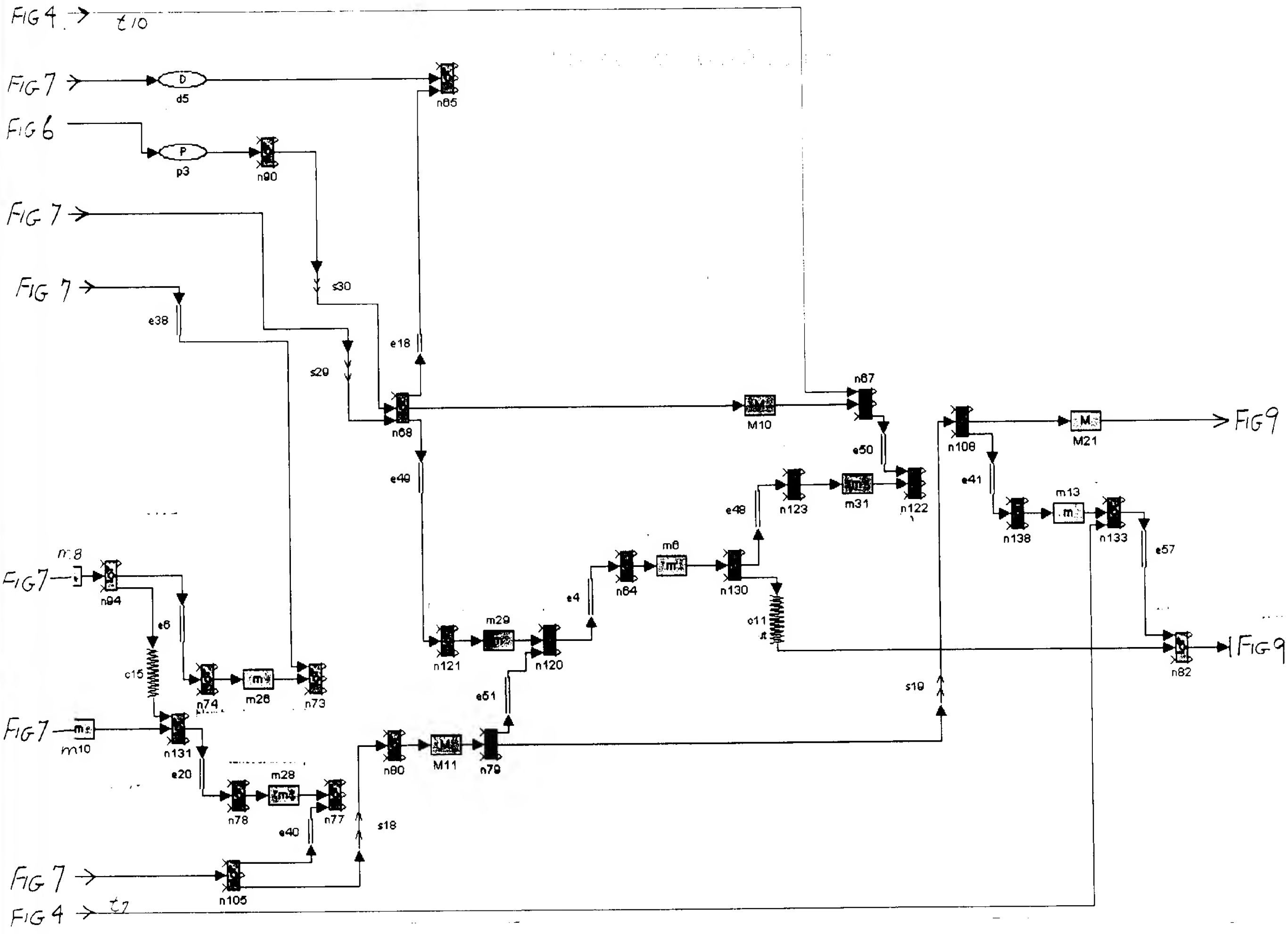


FIG 4
t10
FIG 7
D
d5
n85
FIG 6
P
p3
n90
FIG 7
FIG 7
s30
e38
e18
s29
n68
M10
n67
e50
e49
n123
m31
n122
e48
m8
n64
n130
e4
n94
e6
c15
n74
m26
n73
n121
m29
n120
c11
n108
M21
FIG 9
e41
n138
m13
n133
e57
n82
FIG 9
s19
e51
FIG 7
m10
n131
e20
n78
m28
n77
n80
M11
n79
e40
s18
FIG 7
n105
FIG 4
t7

FIG 8

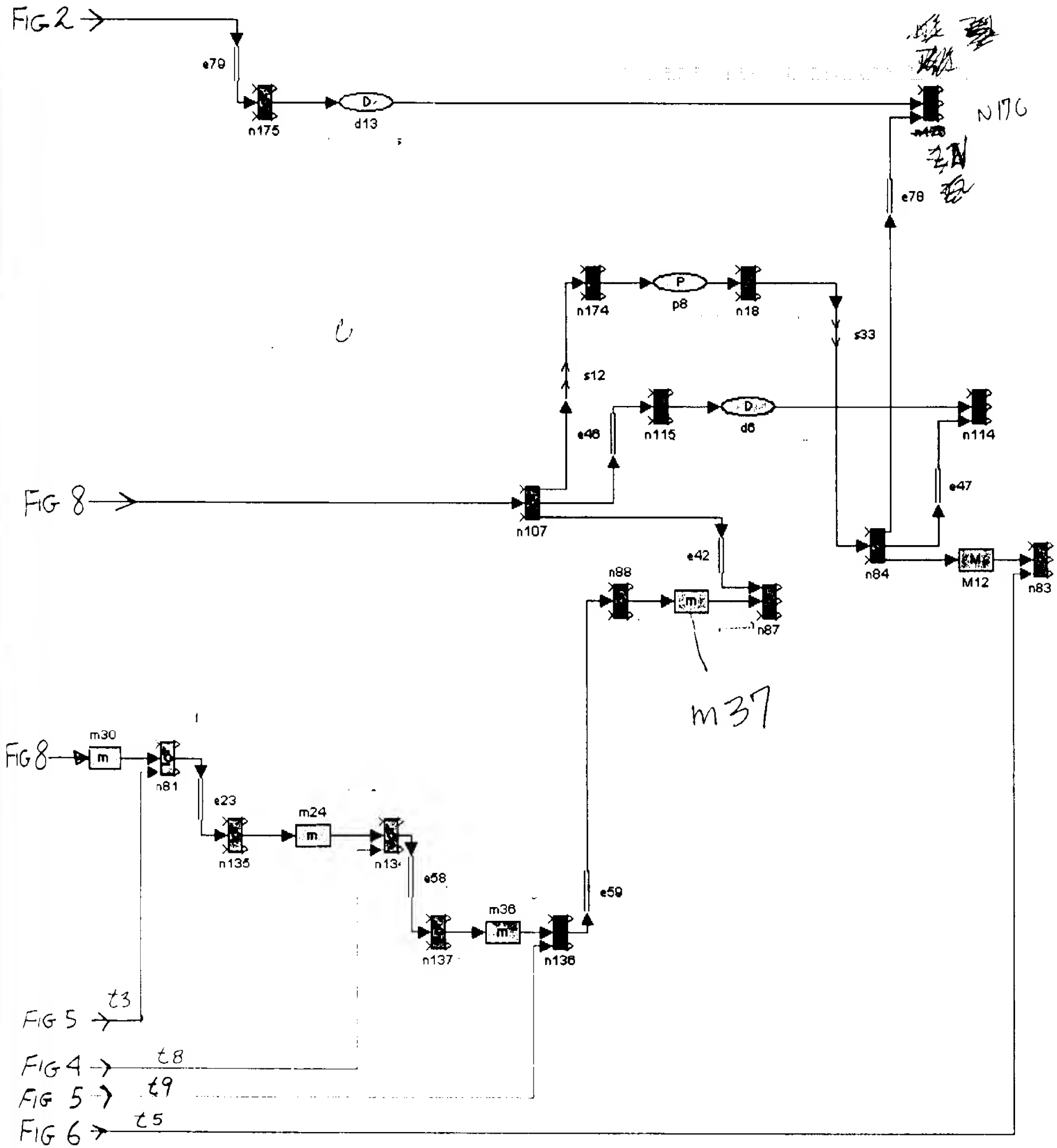


FIG 2
e79
n175
d13
n176
e78
n174
p8
n18
s33
s12
e46
n115
d6
n114
e47
FIG 8
n107
e42
n84
M12
n83
n88
n87
m37
FIG 8
m30
n81
e23
n135
m24
n137
e58
m36
n136
e59
FIG 5
t3
FIG 4
t8
FIG 5
t9
FIG 6
t5

Fig 9

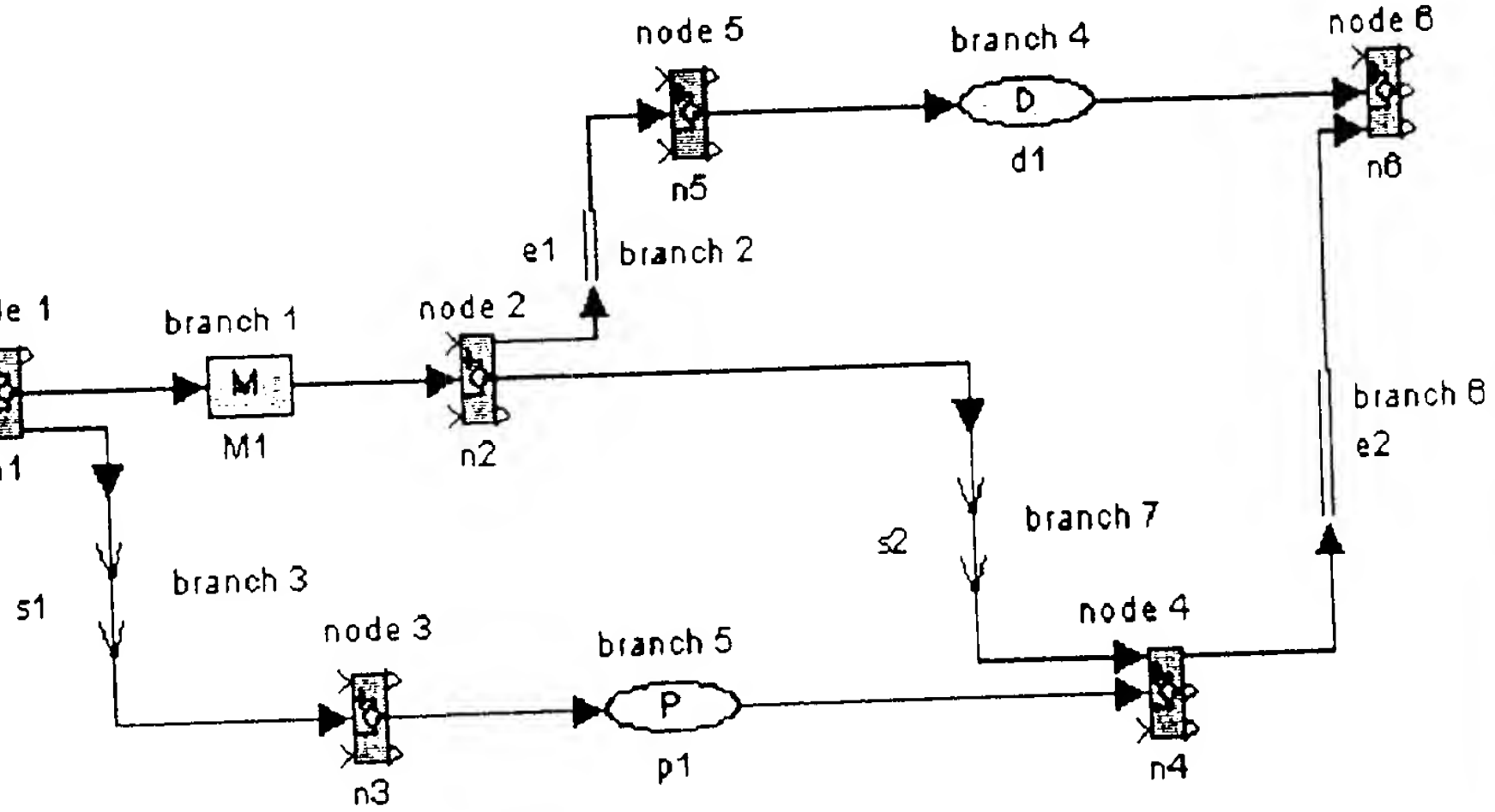
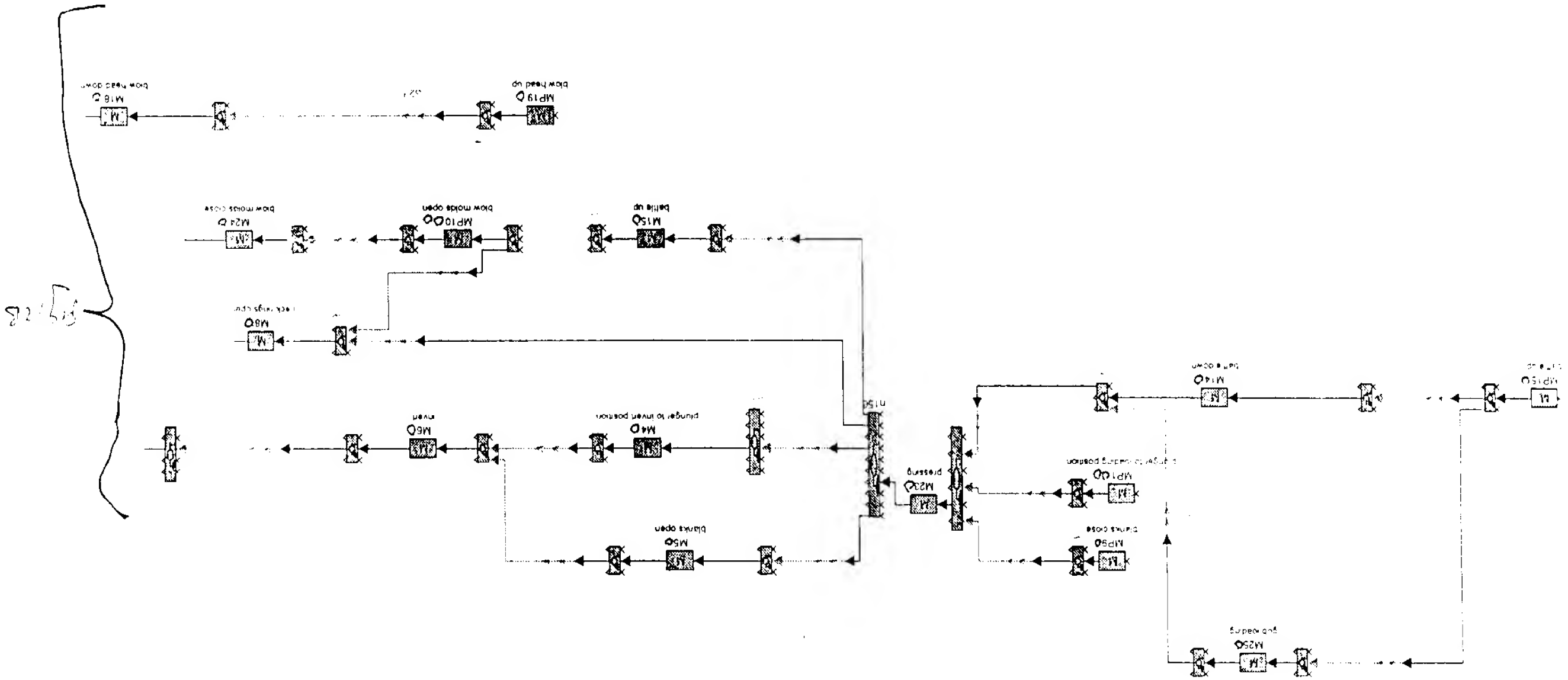

node 5
branch 4
node 6
D
d1
n5
n6
e1
branch 2
node 1
branch 1
node 2
M
M1
n1
n2
branch 8
e2
branch 7
s2
branch 3
s1
node 4
node 3
branch 5
P
p1
n3
n4

Fig- 10

		G	H
1	**Events**	ON	OFF
2	Gob Interceptor	334	14
3	Blanks Close	324	130
4	Blanks Open	130	321
5	Plunger Up	33	123
6	First Baffle	9	125
7	Plunger Down	127	327
8	Funnel	1	150
9	Settle Blow	1	1
10	Plunger Cooling	150	260
11	Invert	200	260
12	Neckring Open	274.5	283
13	Revert	282	172
14	Molds Close/Open	229	170
15	Mold Cooling	10	150
16	Blowhead	290	113
17	Final Blow	348	120
18	Take Out IN	137	197
19	Tongs Close	178	78
20	Take Out OUT	197	90

Fig - 11

Fig-18A


blow head up
MP19
M19
blow head down
M18
blow molds close
M24
blow molds open
MP10
M10
ballle up
M15
rack rings open
M8
plunger to invert position
M4
invert
M6
n150
blanks open
M5
pressing
M23
plunger to loading position
MP1
M1
blanks close
MP9
M9
down
M14
MP15
M15
guide loading
M25

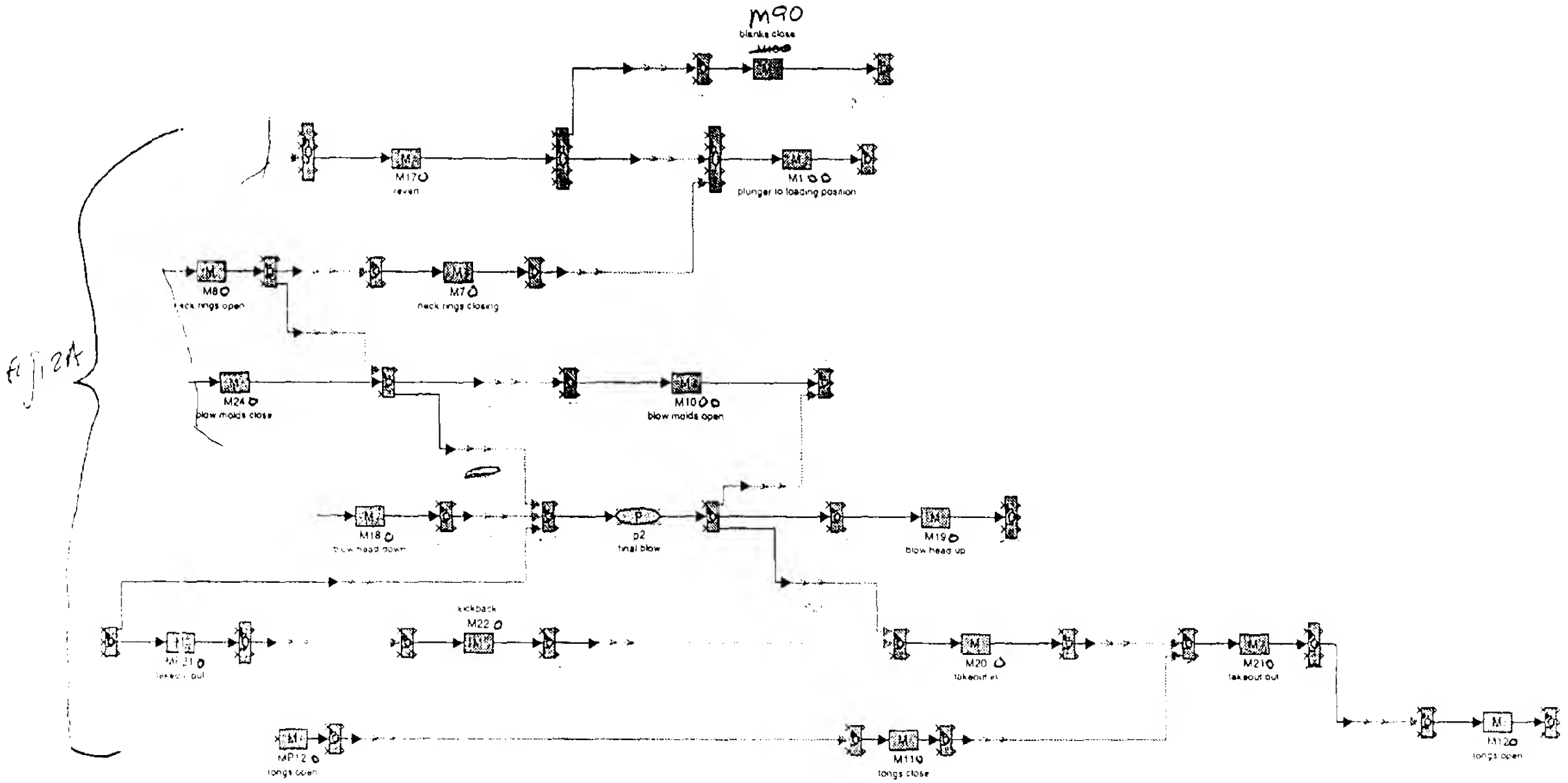


Fig 12A

Fig 12B

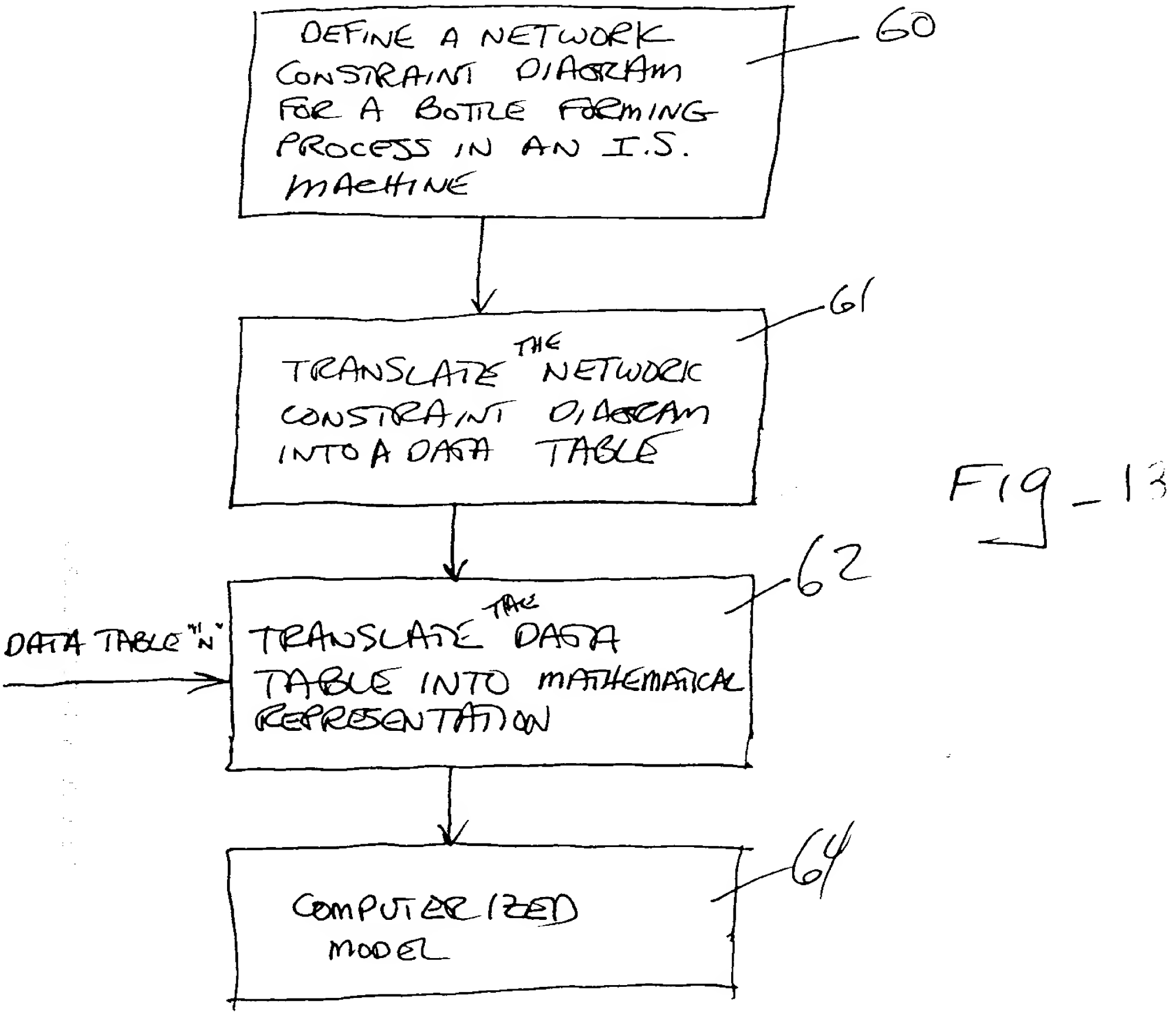
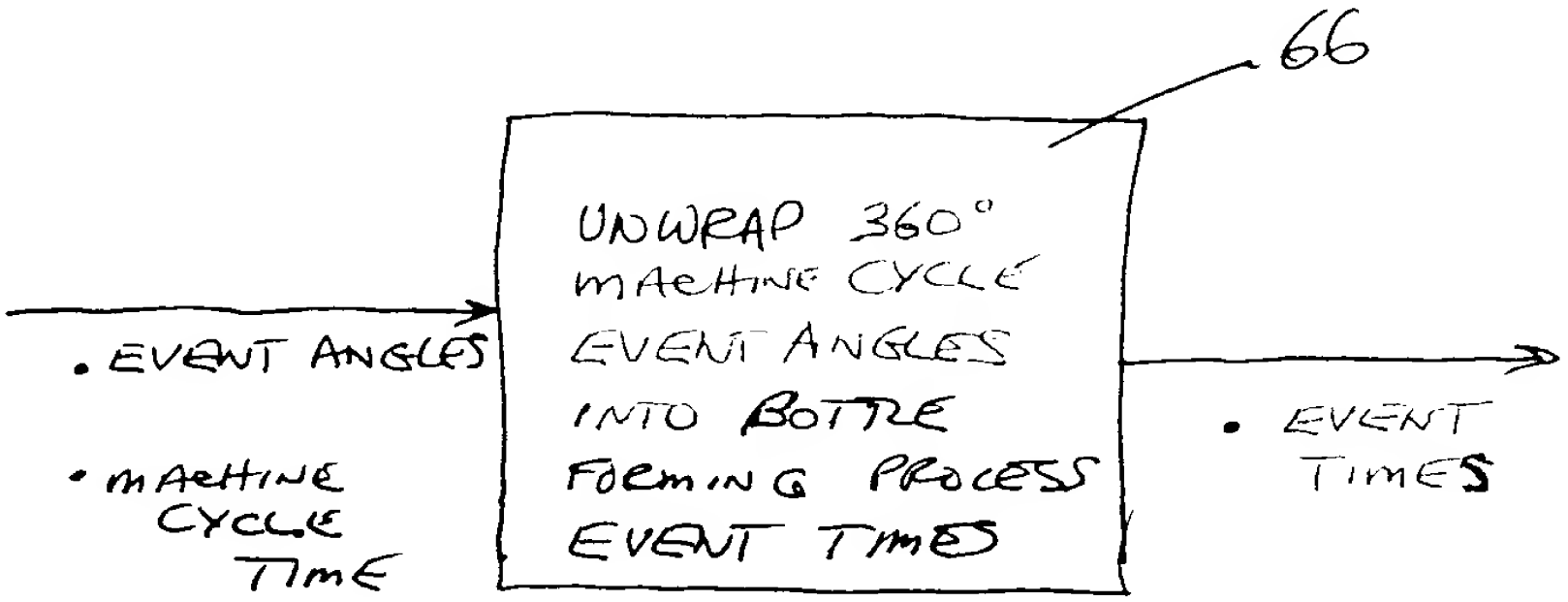

DEFINE A NETWORK CONSTRAINT DIAGRAM FOR A BOTTLE FORMING PROCESS IN AN I.S. MACHINE
60
TRANSLATE THE NETWORK CONSTRAINT DIAGRAM INTO A DATA TABLE
61
DATA TABLE "N"
TRANSLATE THE DATA TABLE INTO MATHEMATICAL REPRESENTATION
62
COMPUTERIZED MODEL
64

Fig_13


66
UNWRAP 360° MACHINE CYCLE EVENT ANGLES INTO BOTTLE FORMING PROCESS EVENT TIMES
• EVENT ANGLES
• MACHINE CYCLE TIME
• MOTION DURATIONS
• EVENT TIMES

F19_14

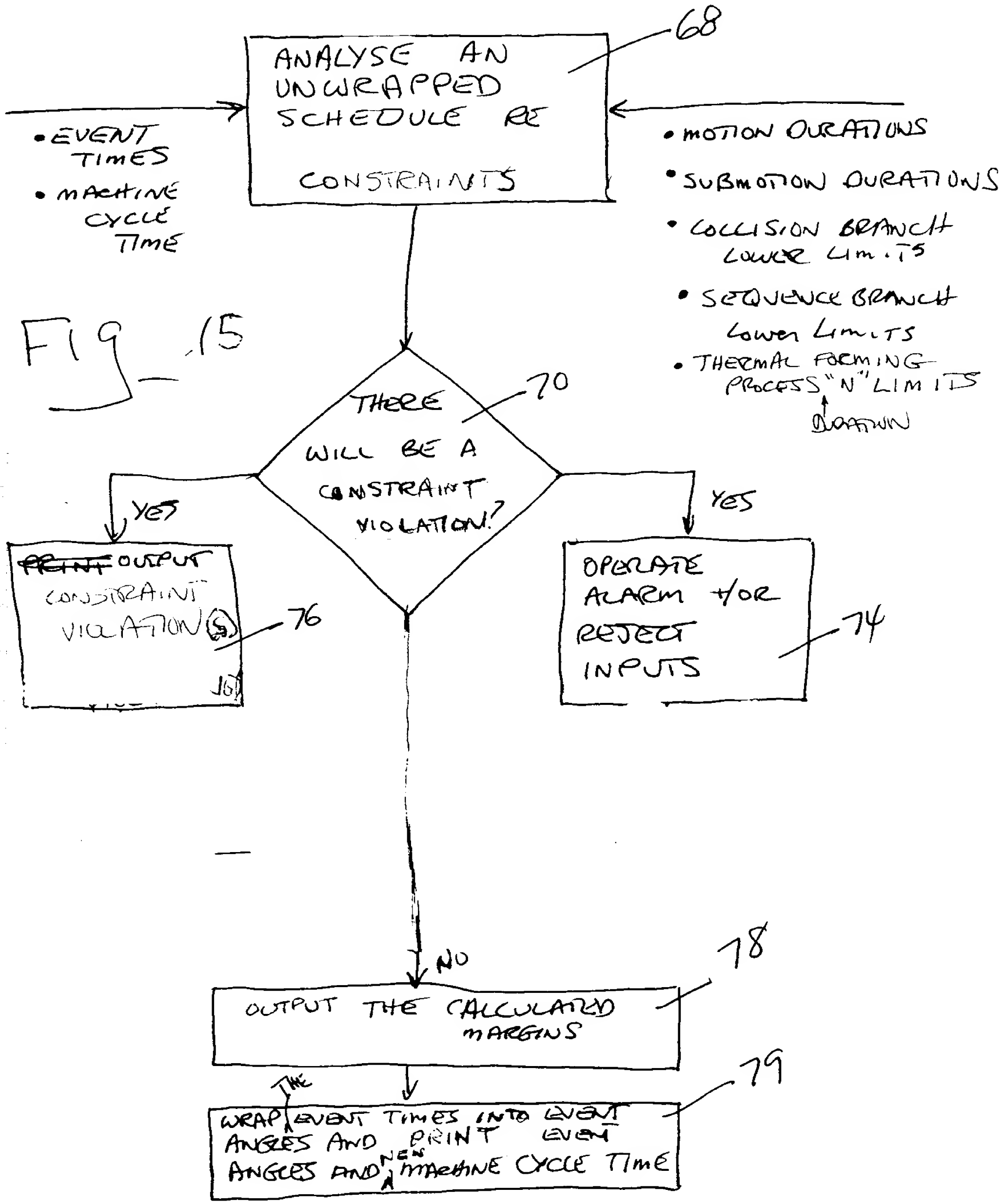

68
ANALYSE AN UNWRAPPED SCHEDULE RE
CONSTRAINTS
• EVENT TIMES
• MACHINE CYCLE TIME
• MOTION DURATIONS
• SUBMOTION DURATIONS
• COLLISION BRANCH LOWER LIMITS
• SEQUENCE BRANCH LOWER LIMITS
• THERMAL FORMING PROCESS "N" LIMITS
DURATION
70
THERE WILL BE A CONSTRAINT VIOLATION?
YES
YES
PRINT OUTPUT CONSTRAINT VIOLATION(S)
76
OPERATE ALARM +/OR REJECT INPUTS
74
NO
78
OUTPUT THE CALCULATED MARGINS
79
WRAP THE EVENT TIMES INTO EVENT ANGLES AND PRINT EVENT ANGLES AND NEW MACHINE CYCLE TIME

FIG. 15

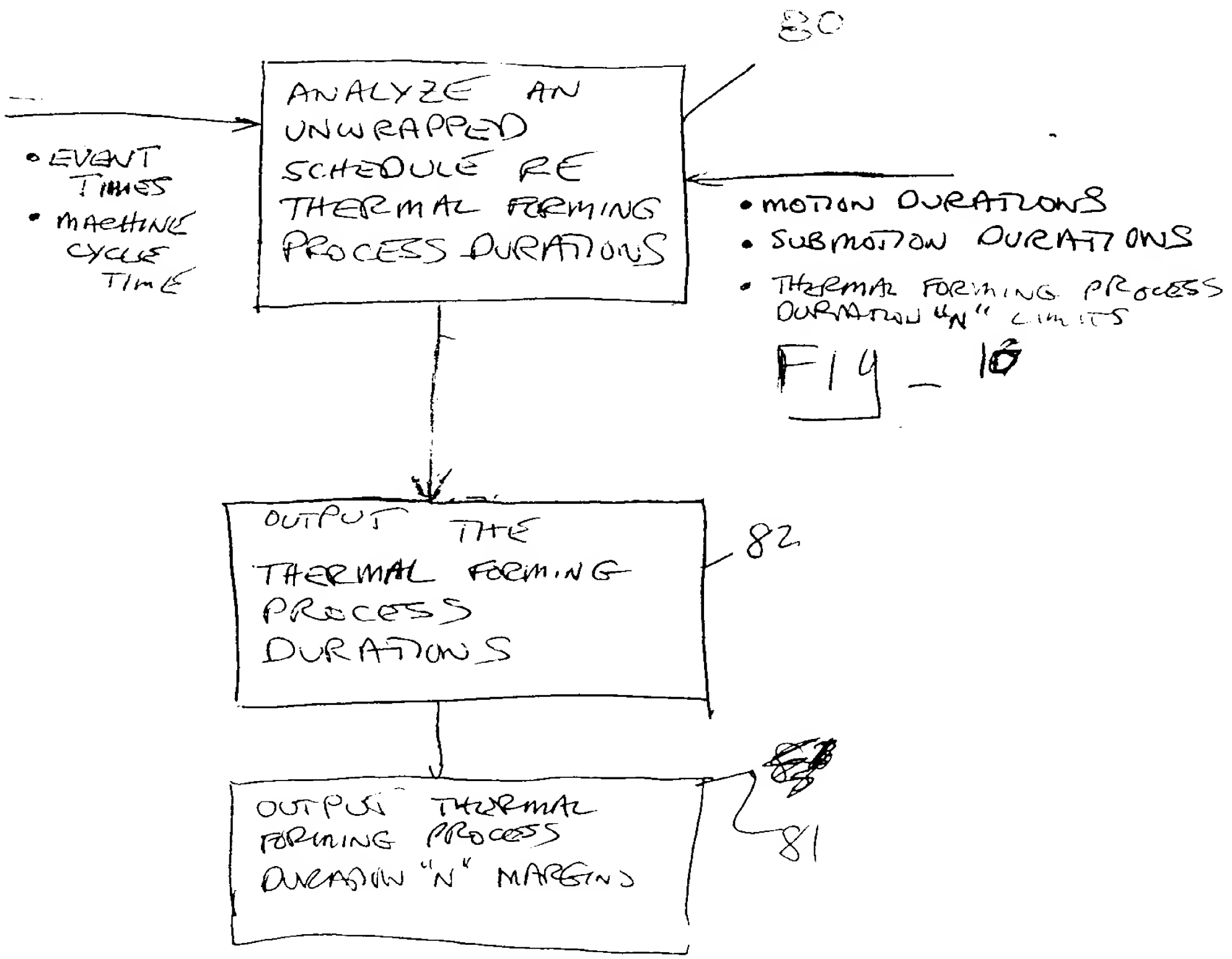

80
ANALYZE AN UNWRAPPED SCHEDULE RE THERMAL FORMING PROCESS DURATIONS
• EVENT TIMES
• MACHINE CYCLE TIME
• MOTION DURATIONS
• SUBMOTION DURATIONS
• THERMAL FORMING PROCESS DURATION "N" LIMITS
OUTPUT THE THERMAL FORMING PROCESS DURATIONS
82
OUTPUT THERMAL FORMING PROCESS DURATION "N" MARGINS
81

FIG - 10

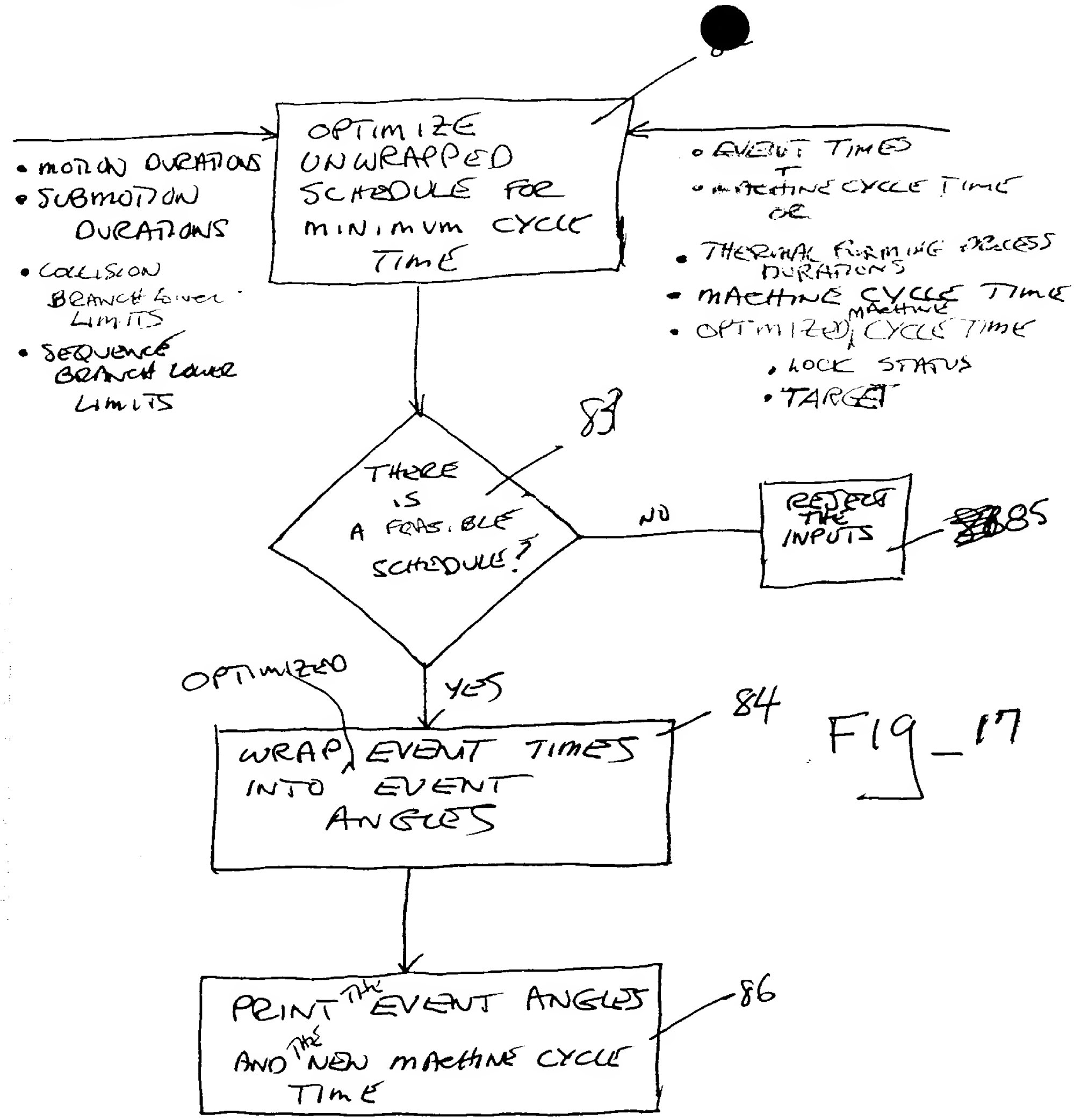

OPTIMIZE UNWRAPPED SCHEDULE FOR MINIMUM CYCLE TIME
• MOTION DURATIONS
• SUBMOTION DURATIONS
• COLLISION BRANCH LOWER LIMITS
• SEQUENCE BRANCH LOWER LIMITS
• EVENT TIMES
• MACHINE CYCLE TIME OR
• THERMAL FORMING PROCESS DURATIONS
• MACHINE CYCLE TIME
• OPTIMIZED MACHINE CYCLE TIME
• LOCK STATUS
• TARGET
83
THERE IS A FEASIBLE SCHEDULE?
NO
REJECT THE INPUTS
85
YES
OPTIMIZED
84
WRAP EVENT TIMES INTO EVENT ANGLES
PRINT THE EVENT ANGLES AND THE NEW MACHINE CYCLE TIME
86

FIG_17

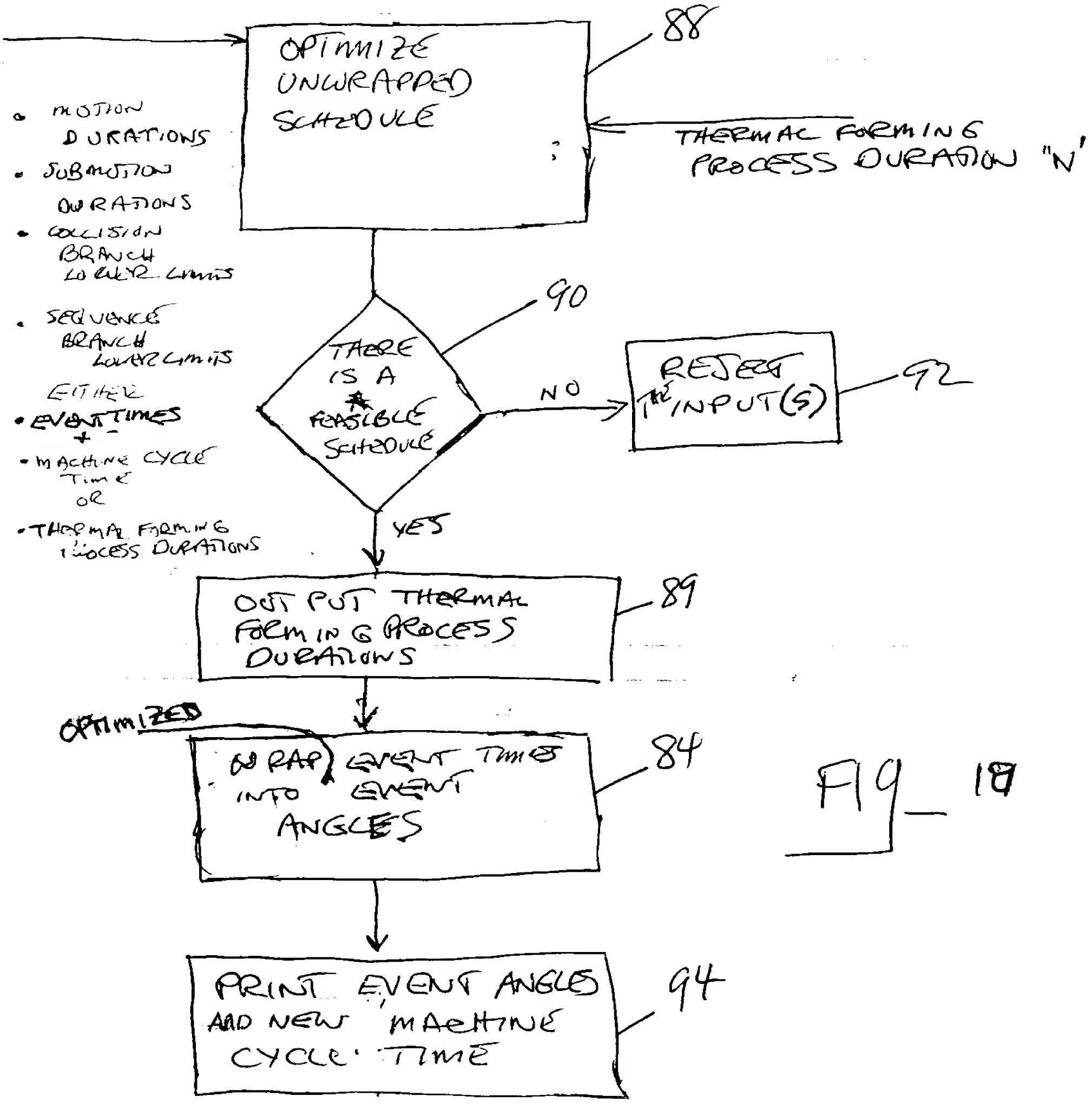

OPTIMIZE UNWRAPPED SCHEDULE
88
• MOTION DURATIONS
• SUBMOTION DURATIONS
• COLLISION BRANCH LOWER LIMITS
• SEQUENCE BRANCH LOWER LIMITS
EITHER
• EVENT TIMES + -
• MACHINE CYCLE TIME
OR
• THERMAL FORMING PROCESS DURATIONS
THERMAL FORMING PROCESS DURATION "N"
THERE IS A FEASIBLE SCHEDULE
90
NO
REJECT THE INPUT(S)
92
YES
OUTPUT THERMAL FORMING PROCESS DURATIONS
89
OPTIMIZED
UNWRAP EVENT TIMES INTO EVENT ANGLES
84
PRINT EVENT ANGLES AND NEW MACHINE CYCLE TIME
94

FIG_ 10

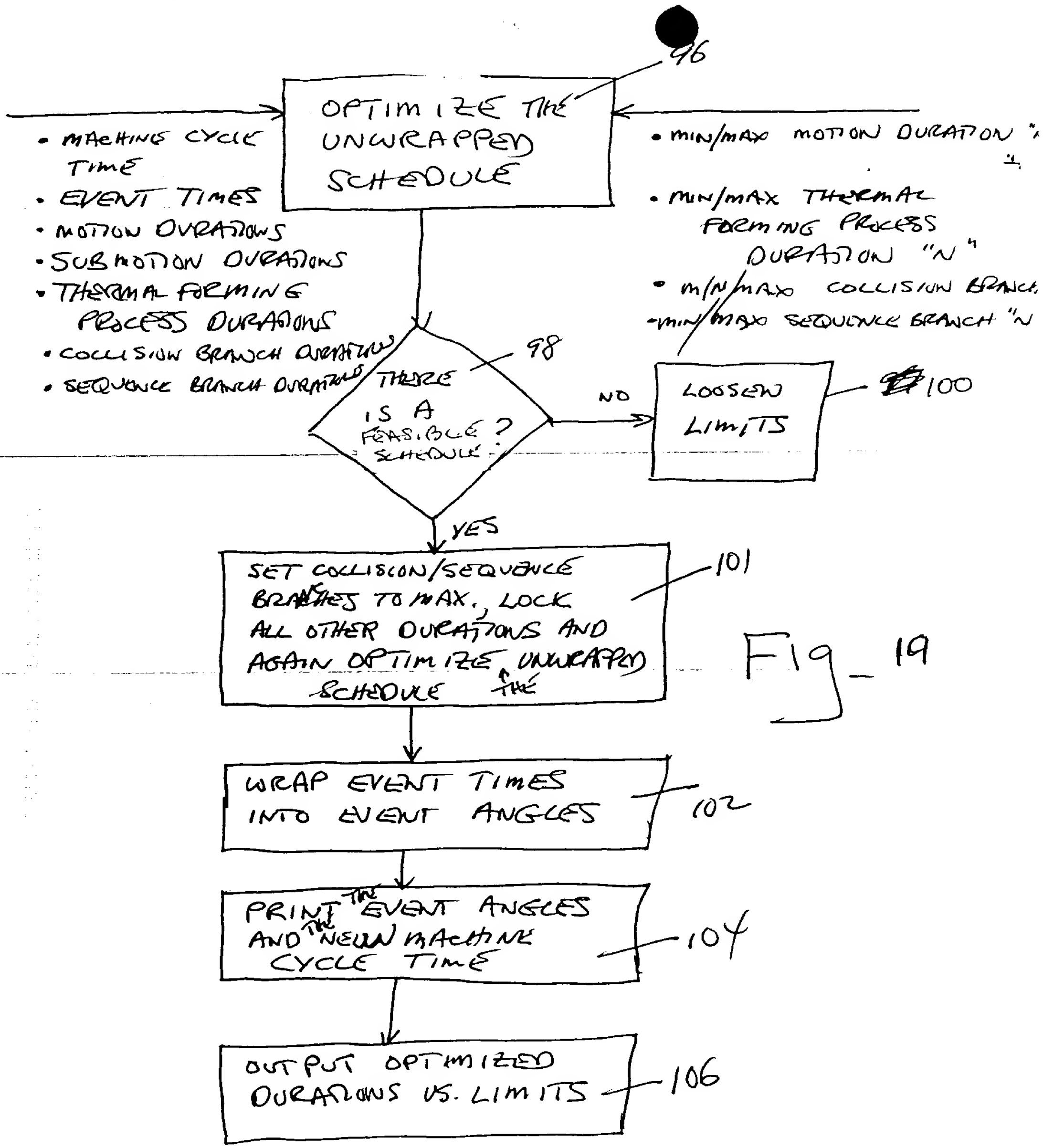

96
OPTIMIZE THE UNWRAPPED SCHEDULE
• MACHINE CYCLE TIME
• EVENT TIMES
• MOTION DURATIONS
• SUBMOTION DURATIONS
• THERMAL FORMING PROCESS DURATIONS
• COLLISION BRANCH DURATIONS
• SEQUENCE BRANCH DURATIONS
• MIN/MAX MOTION DURATION "1
• MIN/MAX THERMAL FORMING PROCESS DURATION "N"
• M/N/MAX COLLISION BRANCH
-MIN/MAX SEQUENCE BRANCH "N
98
THERE IS A FEASIBLE SCHEDULE?
NO
LOOSEN LIMITS
100
YES
SET COLLISION/SEQUENCE BRANCHES TO MAX., LOCK ALL OTHER DURATIONS AND AGAIN OPTIMIZE UNWRAPPED SCHEDULE
101
WRAP EVENT TIMES INTO EVENT ANGLES
102
PRINT EVENT ANGLES AND NEW MACHINE CYCLE TIME
104
OUTPUT OPTIMIZED DURATIONS VS. LIMITS
106

Fig_19

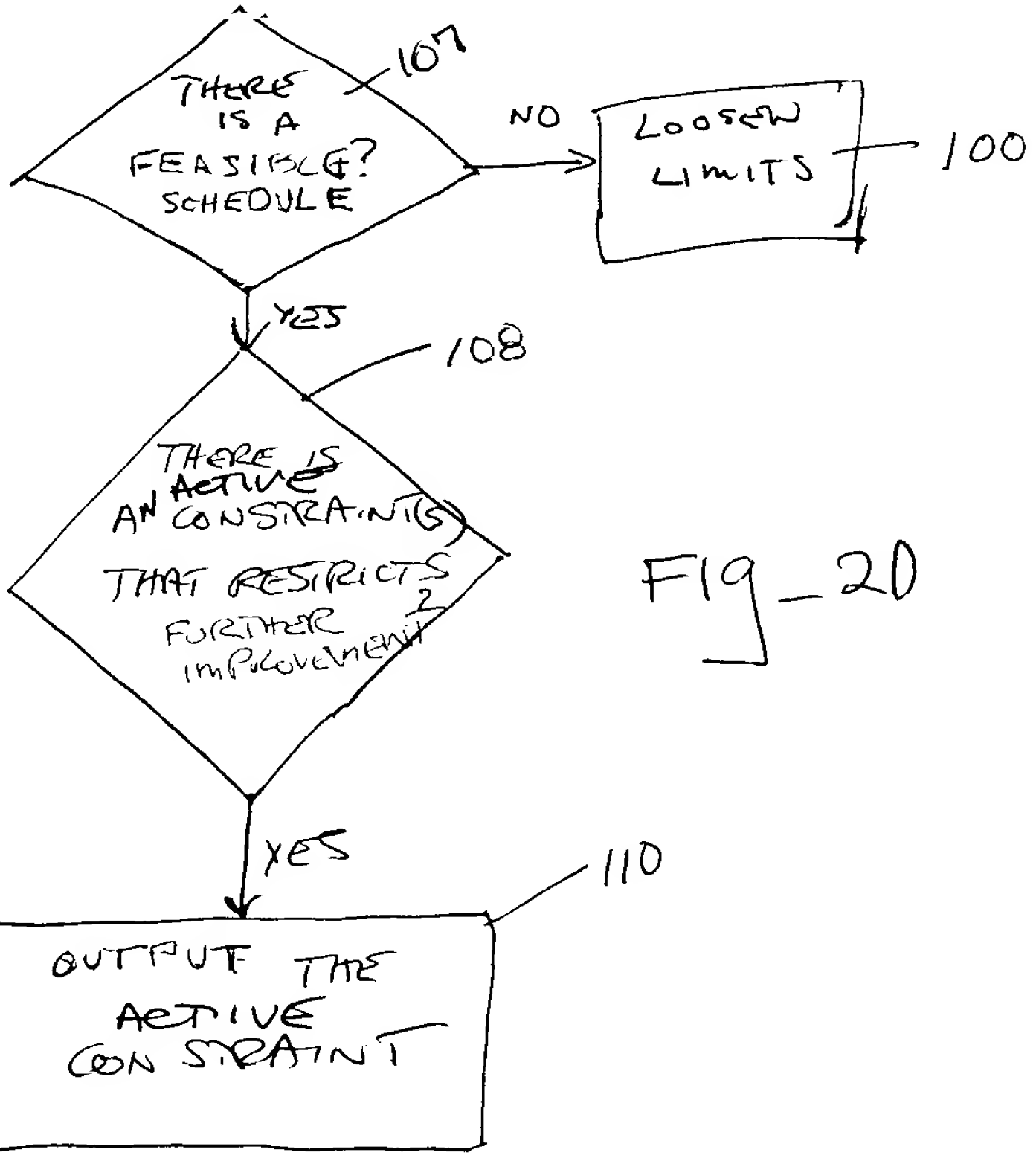

THERE IS A FEASIBLE SCHEDULE?
107
NO
LOOSEN LIMITS
100
YES
108
THERE IS AN ACTIVE CONSTRAINT THAT RESTRICTS FURTHER IMPROVEMENT?
YES
110
OUTPUT THE ACTIVE CONSTRAINT

FIG_20

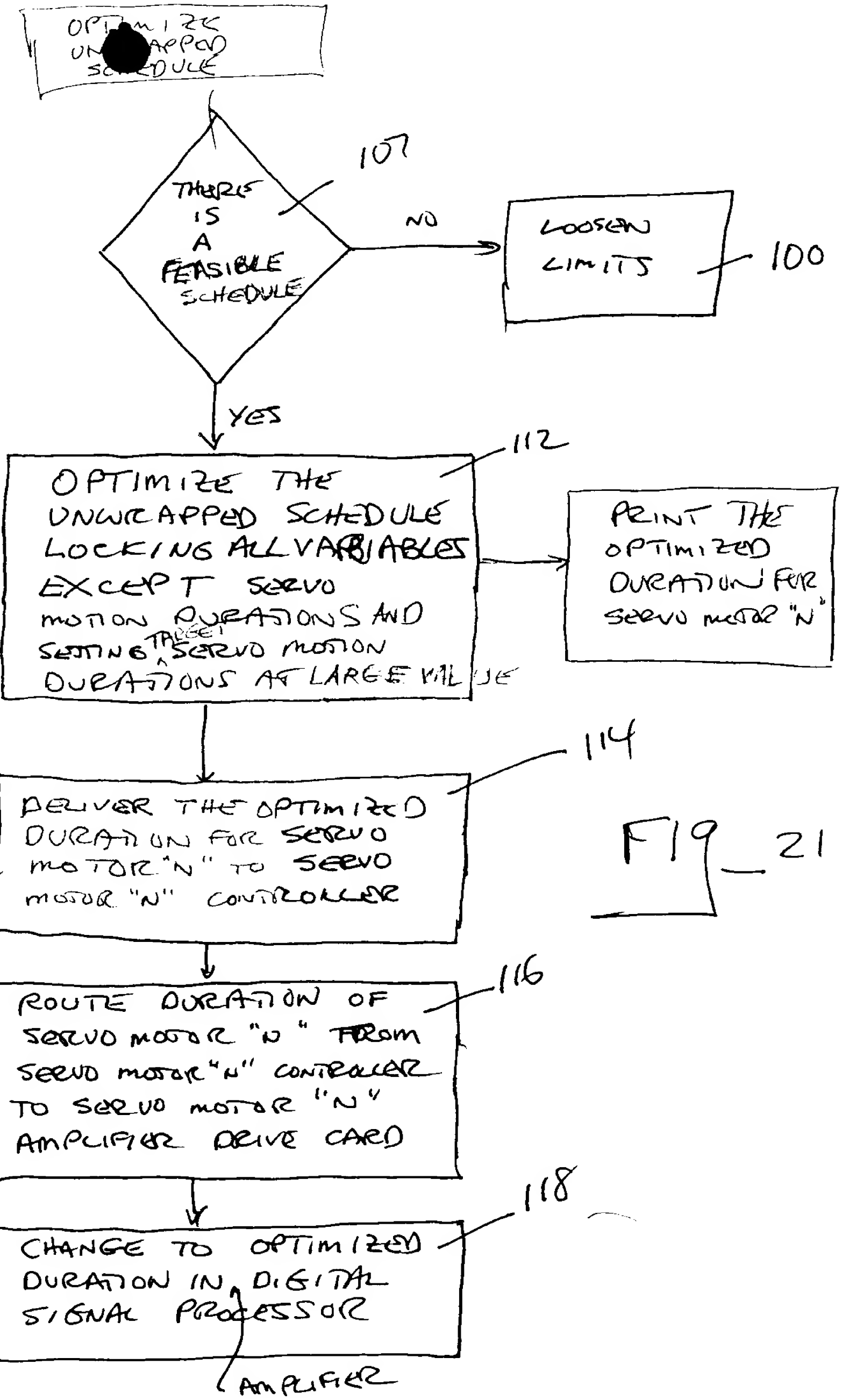

OPTIMIZE UNWRAPPED SCHEDULE
THERE IS A FEASIBLE SCHEDULE
107
NO
LOOSEN LIMITS
100
YES
112
OPTIMIZE THE UNWRAPPED SCHEDULE LOCKING ALL VARIABLES EXCEPT SERVO MOTION DURATIONS AND SETTING TARGET SERVO MOTION DURATIONS AT LARGE VALUE
PRINT THE OPTIMIZED DURATION FOR SERVO MOTOR "N"
114
DELIVER THE OPTIMIZED DURATION FOR SERVO MOTOR "N" TO SERVO MOTOR "N" CONTROLLER
116
ROUTE DURATION OF SERVO MOTOR "N" FROM SERVO MOTOR "N" CONTROLLER TO SERVO MOTOR "N" AMPLIFIER DRIVE CARD
118
CHANGE TO OPTIMIZED DURATION IN DIGITAL SIGNAL PROCESSOR
AMPLIFIER

FIG_21